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The small-scale manufacture of high and low boiled sweets and toffees

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Mary N. A. Hall

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Tropical Products Institute, 56/62 Gray's Inn Road, London WC1X 8LU

Foreign and Commonwealth Office (Overseas Development Administration)

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Requests for further information should be addressed to:

The Director
Tropical Products Institute
56/62 Gray's Inn Road
London WC1X 8LU

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SUMMARY

This report is one of a series designed to help prospective investors in developing countries to assess the economic viability of various small scale industries. The manufacturing process is described and the capital and running costs involved in operating such a process are analysed. The report is intended to be applicable to a wide variety of developing countries and, although cost models are based on actual prices in West Africa and converted to sterling, sufficient detail has been included so that users in various countries who are carrying out feasibility surveys can apply their own local cost information to each physical unit and obtain relevant results.

Cost models have been worked out for three scales of output:

A, up to one ton per week, B, five tons and C, twenty tons weekly.

These require total investments in buildings, plant etc of £9,000, £54,000 and £165,000 which items include investments in working capital of £2,000, £8,000 and £28,000 respectively. It is emphasised that these investment costs are only applicable to the simplified models chosen and for prices ruling in 1970; costs are increasing due to inflation and fresh quotations should be obtained for greater accuracy. Addresses of suppliers are given in the appendix. The three scales are chosen from the range of small scale manufacture as representative of three stages in development from the traditional village cottage industry to a small establishment incorporating some labour saving machinery and supplying a limited area, and further, to one which depends largely upon semi-automatic processes and supplies a wide area. To move beyond these limits requires heavy investment in high speed fully automatic machinery and large market outlets, both of which lie outside the scope of this report. The cost information has been tabulated to show probable gross profits and returns on capital for the three scales of output.

An analysis of the models is given and variations on the working assumptions are considered and the results discussed. It has been assumed that output for all processes will be no higher than 80 per cent of the amount specified by the manufacturers in view of the probable lack of skilled labour. Distribution costs are high in developing countries and therefore a margin of 40 per cent of the retail sales price has been allowed for these in the calculation of the sales revenue. Ingredient costs represent about 50 per cent of total annual operating cost and the profitability of all three models is highly sensitive to changes in their prices. Labour costs represent a smaller percentage of total costs and increases in these have a relatively smaller adverse effect on profitability, particularly for scale C.

The common methods of manufacture have been discussed and some background explanation of boiling and cooling processes has been included where this is helpful to a general understanding of the manufacture of high boiled sweets and

toffees. Problems arising out of the effect of tropical conditions on sweet manufacture have been mentioned, in particular those concerned with air temperature and humidity control, wrapping, storage and scrap utilisation. Manufacturers and suppliers of materials and machinery stress the importance of expert advice in the choice of methods and welcome enquiries from overseas. Advice on overseas problems is also given by experts in the trade journals which should be consulted in the planning stages. A list of names and addresses is appended for sources of information.

SOMMAIRE: La fabrication des bonbons et caramels

Ce rapport qui fait partie d'une série conçue à l'intention des investisseurs éventuels dans les pays en voie de développement, a pour objet de leur permettre de déterminer la viabilité économique des diverses industries du secteur secondaire. Il comprend la description du procédé de fabrication ainsi que l'analyse des immobilisations et des frais d'exploitation que comportent l'exploitation d'un procédé de cette nature. Le rapport est destiné à être applicable à divers pays en voie de développement et, bien que les frais types cités sont basés sur les prix courants en Afrique Occidentale et convertis ensuite en livres sterling, des précisions suffisantes y ont été comprises afin de permettre aux usagers, réalisant une étude de praticabilité en de divers pays, d'appliquer à chaque élément les informations obtenues sur place concernant les frais et d'obtenir ainsi les résultats correspondants.

Les frais types de rendement sur trois échelles différentes ont été calculés:

A, jusqu'à une tonne par semaine; B, cinq tonnes et C, vingt tonnes par semaine.

Les investissements nécessaires sous forme de bâtiments, installations, etc . . ., totalisent £9 000, £54 000 et £165 000, dont £2 000, £8 000 et £28 000 de capitaux investis respectivement en fonds de roulement. Il est précisé que ces fonds nécessaires ne s'appliquent qu'aux types simplifiés qu'on a choisi et que les calculs sont basés sur les prix en vigueur en 1970; en raison de l'inflation, les prix ont augmenté et, pour plus d'exactitude dans le calcul, il serait prudent d'obtenir des tarifs plus récents. Les adresses des fournisseurs se trouvent annexées. Les trois échelles sont choisies à partir de la gamme de l'activité du secteur secondaire qui correspond à trois stades d'évolution, depuis l'artisanat traditionnel du village au petit établissement comprenant certaines machines pour alléger le travail de la main-d'oeuvre et approvisionnant une zone limitée, pour arriver enfin au secteur d'activité qui dépend, dans une large mesure, des procédés semi-automatiques et approvisionne une vaste zone. Pour s'étendre au delà de ces limites, d'importants investissements tant en machinerie à grand rendement complétement automatique qu'en l'expansion de débouchés sont nécessaires — ces deux domaines se trouvent hors de la portée de ce rapport. Le prix de revient a été représenté sous forme de tableau exprimant le bénéfice brut et la rémunération du capital probables pour chacune des trois échelles de rendement.

Le rapport comprend l'analyse des investissements types, l'évaluation des variations d'hypothèses et la discussion des résultats. On a supposé que le taux de rendement pour tous les procédés ne serait pas supérieur à 80 pour cent du taux prévu par les fabricants étant donné le manque probable de main-d'oeuvre qualifiée. Dans les pays en voie de développement les frais de distribution sont assez élevés et, pour en tenir compte, on a donc retenu, dans le calcul du produit de ventes, une marge de 40 pour cent sur le prix de vente au détail. Le prix des ingrédients représente 50 pour cent environ du montant total des frais d'exploitation annuels et, pour tous les trois types la rentabilité est trés sensiblement affectée par les mouvements de ces prix. Les frais de main-d'oeuvre ne représentent qu'un faible pourcentage du prix de revient total et une augmentation de ceux-ci n'exerce qu'une faible influence défavorable sur la rentabilité, notamment sur celle de l'échelle C.

On a inclus la discussion des méthodes courantes de fabrication ainsi que certaines informations sur les procédés de cuisson et de refroidissement où ceci est nécessaire à la compréhension de la fabrication des bonbons et caramels. Les problémes qui résultent de l'influence des conditions climatologiques sur la fabrication des bonbons se trouvent mentionnés, notamment ceux de la température et de l'humidité sur l'emballage, le stockage et l'utilisation des déchets. Les fabricants et les concessionnaires de machines et d'équipements insistent sur le fait qu'il est important d'obtenir les conseils d'un expert en ce qui concerne le choix des méthodes et ils accueillent toutes demandes de renseignements provenant de l'étranger. Les publications professionelles qu'il faudrait consulter quand ces projects sont encore à l'étude, donnent aussi des conseils sur les problémes auxquels on fait face dans les pays d'outre-mer. Une liste des noms et des adresses auxquels on peut s'adresser pour tous renseignements complémentaires se trouve annexée.

RESUMEN: La fabricación de caramelos y de dulces

El presente informe es parte de una serie de ellos cuyo cometido es el de orientar a los posibles inversionistas en países en fase de desarrollo, en cuanto a la factibilidad económica de diversas industrias a pequeña escala. Se detalla el proceso de fabricación y se analiza el capital y los costos de explotación que suponen un proceso tal. Se tiene la intención de que el informe sea común a una gran variedad de países en fase de desarrollo, y, aunque los modelos de costo se basen en precios que rigen en la actualidad en Africa Occidental y que se han traducido a libras esterlinas, se ofrece suficiente información para que usuarios de diversos países, que estén llevando a cabo investigaciones de factibilidad, puedan aplicar su propia información, relativa a los costos locales, a cada unidad física y obtener de tal manera resultados importantes.

Se han calculado modelos de costo para tres grados de producción: A, hasta para una tonelada por semana, B, para cinco toneladas y C, para veinte toneladas semanales.

Estos precisan inversiones totales en edificios, fábrica, etc. de £9.000, £54.000 y £165.000, en cuyos epígrafes se incluyen inversiones de capital activo de £2.000, £8.000 y £28.000 respectivamente. Se insiste en que estos costos de inversión son aplicables únicamente a los modelos simplificados elegidos y para precios que rigieron en el año 1970; nadie ignora que los costos se incrementan debido a la inflación y, por ende, para mayor exactitud, deben obtenerse nuevos presupuestos. En el apéndice se ofrecen direcciones de proveedores. Los tres ejemplos se han seleccionado de una gama de fabricantes a pequeña escala, representativa de tres fases de desarrollo a partir de la fabricación casera tradicional, hasta el establecimiento de una pequeña industria provista de cierta maquinaria que represente un ahorro de mano de obra y que suministre a una zona limitada, y aun hasta una que se base en su mayor parte en procesos semiautomáticos y cuya zona de abastecimiento sea vasta. Para traspasar estos límites, se requieren grandes inversiones en maquinaria completamente automática y de rápida producción con grandes salidas a los mercados, todo lo cual se sale ya de los límites de este informe. Las tablas de información sobre costos muestran los beneficios brutos y utilidades contra el capital para los tres grados de producción.

Se ofrece un análisis de los modelos y variaciones acerca de datos de explotación que se anticipan, discutiéndose, finalmente, los resultados. Se asume que en las tres escalas, la producción en todos los procesos de fabricación no excederá el 80% de la cantidad que especifiquen los fabricantes, en vista de la posible carencia de mano de obra experta. Los costos de distribución son altos en países en fase de desarrollo, y, por lo tanto, se ha reservado para ellos un 40% del precio de venta al detallista, al tratar de calcular las entradas por concepto de ventas. El costo de los ingredientes representa aproximadamente un 50% del costo total anual de explotación y la ganancia correspondiente a cada modelo se verá afectada por cambios en los precios de tales ingredientes. El costo relativo a la mano de obra representa un porcentaje más reducido de los costos totales y cualquier

incremento por este concepto traerá consigo un efecto adverso, relativamente menor, en cuanto a la ganancia se refiere, especialmente en el modelo C.

Igualmente, se someten a discusión los métodos de fabricación, incluyéndose ciertas explicaciones de antecedentes de los procesos de ebullición y enfriamiento cuando éstas constituyen una ayuda para el entendimiento general de la fabricación de caramelos de alta ebullición y de dulces de azucar con leche. Los problemas que se derivan del efecto de los ambientes tropicales sobre la fabricación de caramelos también se han mencionado, en especial los que se refieren a la temperatura atmosférica y humedad y control de las mismas, envolturas, almacenamiento y utilización de residuos. Los fabricantes y proveedores de materias y de maquinaria puntualizan la importancia de obtener el consejo de expertos a la hora de decidir acerca de los métodos y prestan su mayor atención a las consultas que se les dirige desde el extranjero. En el curso de las fases iniciales de planificación, deben también consultarse las revistas del ramo en las que los expertos exponen sus puntos de vista y sus consejos acerca de problemas que surgen en el extranjero. Se adjunta una lista de nombres y direcciones de quienes se consideran como buenas fuentes informativas.

Chapter 1

Introduction

THE PURPOSE AND SCOPE OF THE REPORT

This report is one of a series designed to help prospective investors in developing countries to assess the economic viability of various small scale industries. The manufacturing process is described and the capital and running costs involved in operating such a process are analysed. The report is intended to be applicable to a wide variety of developing countries and although cost models are based on actual prices in West Africa and converted to sterling, sufficient detail has been included so that users in various countries carrying out feasibility surveys can apply their own local cost information to each physical unit and obtain relevant results.

Sugar confectionery covers a wide range of products which present a variety of problems in their manufacture and storage. Boiled sweets and toffees were chosen since they are comparatively simple to make and relatively trouble-free in storage. The main ingredients of sugar, glucose and vegetable fat are produced in their raw state in many developing countries and there are a growing number of processing plants in these countries which are able to produce a refined product. An expert assessment of the quality of locally available supplies will be necessary in order to decide which inputs must be imported. All confectionery products require some skill in manufacture. Experienced help and knowledge of local conditions are essential for any undertaking, and it is hoped that this report may serve as a guide.

Cost models are worked out for three scales of output: up to one ton per week, five tons and twenty tons weekly. These three scales are chosen from the range of small scale manufacture as representative of three stages in development from the traditional village cottage industry to a small establishment incorporating some labour saving machinery and supplying a limited area, to one which depends largely upon semi-automatic processes and supplies a wide area. To move beyond these limits requires heavy investment in high speed fully automatic machinery and large market outlets, both of which lie outside the scope of this report.

METHOD

The operational data for the three scales of output were collected from various confectionery manufacturers and suppliers in Britain and West Africa. Estimates of capital costs were given by machinery makers and suppliers of second-hand machinery. The cost information has been tabulated to show probable gross profits and returns on capital for the three scales (see Tables 1–5, Appendix 2). The derivations of data are given in the notes to the tables, in Appendix 1. An analysis of the models is given in Chapter 3 in which variations on the working assumptions are considered and results discussed.

Some general considerations on the choice of the scale of output are outlined in Chapter 4. A product mix of five parts in weight of boiled sweets to two parts

by weight of toffee was thought to be appropriate being typical of consumer preferences in parts of West Africa. There are an infinite variety of sweet recipes to choose from and those used are representative of a standard economical boiled sweet and of a toffee suitable for use in the tropics (see Appendix 1, page 26). A general account of the manufacturing processes and conditions of storage is given in the following chapter.

Chapter 2

Manufacture and materials

OUTLINE OF PROCESSES

High boiled sweets, such as fruit drops and rocks, are made by boiling sucrose, glucose and water together in large pans to temperatures of the order of 300°–320°F (150°–160°C). The syrup is then poured onto large cast iron tables where it cools rapidly to a pliable mass which can be handled. Colour and flavouring agents are kneaded lightly into the batch which is then shaped by hand or by machine rollers to a convenient size for passing through rotary dies which mould the sweets. After some cooling, the sweets are wrapped by machine or hand processed and packed in airtight containers.

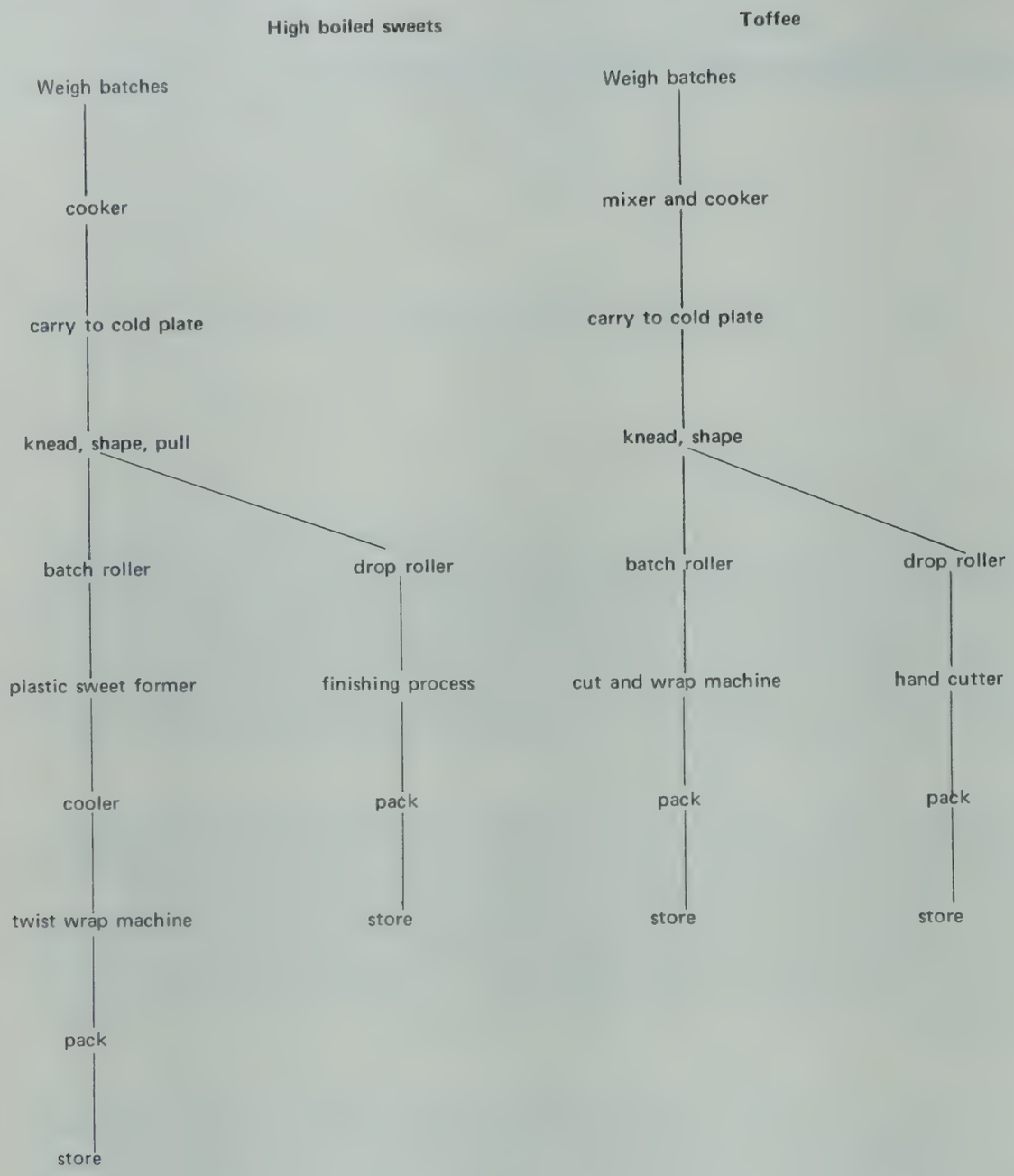
Low boiled sweets, such as creams and fudges are also made by boiling sucrose, glucose and water together in large containers but to lower temperatures, 240°–270°F (115°–132°C), often with the addition of fats and milk products. The syrup is then cooled to a certain temperature before being beaten to encourage the formation of fine crystals, when it is poured into a frame set on a cold table and left to continue the crystallising process. This cooled mass sets to a finely grained creamy product, which can be cut into squares and has excellent keeping properties.

Toffees are a type of boiled sweet made from sucrose, glucose, water, fats, milk and emulsifying products. The ingredients are mixed together in the container for some time before cooking to ensure that the fats, solids and liquids are evenly distributed throughout the mass, or emulsified. When milk is heated with sugar, it partially decomposes or caramelises to give the characteristic flavour of caramels and toffees. The fat tends to separate out during the cooking period and so an emulsifying agent is added to prevent this: suitable agents are milk, gelatin and lecithin, often in the form of powdered soya product. The emulsified ingredients are then heated in the container and continuously stirred until a temperature between 260°–280°F (126°–138°C) is reached when the boiling syrup is poured out onto long cast iron tables to cool. Crystallisation of the toffee is inhibited by the high proportion of glucose syrup in the mix, about a third the weight of raw materials used. The soft toffee can be cut by hand into blocks for subsequent hand wrapping or it may be shaped in a heated batch roller and fed into a machine which cuts it and wraps the pieces ready for packing.

EXPLANATION OF BOILING AND COOLING PROCESSES

High boiled sweets, sometimes known as high boilings or hard boiled sweets, are concentrated solutions of sucrose which have been cooled to form a transparent solid containing less than 2 per cent moisture. Under normal conditions, the sucrose would crystallize to form an opaque sugar mass with a rought crystalline texture, but this can be prevented by the addition of invert sugar or glucose syrup. Both of these contain dextrose which inhibits the crystallization of sucrose by being absorbed on the newly formed crystal surfaces and protecting it from further

WORK-FLOW CHART



growth. The addition of dextrose to prevent crystallization is called 'doctoring' and is an essential part of the production of boiled sweets. Most of the difficulties encountered in manufacture are concerned with adjusting conditions so that crystallization is avoided or controlled so that a smooth or fine-grained product is obtained. When sucrose is boiled in the presence of acids, such as citric, tartaric or malic acids, some of the sucrose is broken down to invert sugar which will then affect the crystallization point of the solution by the doctoring action of the newly-formed dextrose. The results of acid boiling are extremely variable and difficult to control and so this method of doctoring has been supplanted by the use of glucose syrup which is a reliable and tolerant agent. Glucose syrup has the additional advantages over invert sugar of reducing breakage of the sweet, increasing its chewiness and slow-dissolving properties and lessening its tendency to absorb moisture from the atmosphere. Glucose syrup is made by the conversion of starch into dextrose and certain other sugars. Crystalline dextrose is sometimes called glucose when used medicinally, but this report follows the confectionery industry in the use of the term glucose as referring to the syrup.

Sucrose and glucose syrup are used in the proportions by weight of 70:30 for open pan cooking and 60:40 for vacuum cooking. When the ingredients have been measured into the cooking vessel together with sufficient water to dissolve the sugar completely, the mixture is heated strongly until it boils. Great care is

taken to see that there are no undissolved crystals of sugar left in the vessel which would encourage unwanted crystallization later on in the process. The boiling point rises as water is driven off and the sugar solution becomes more concentrated. For each type of sweet, the temperature reached in the boiling process is very important since it defines the amount of water left in the syrup and thus the texture that the final product can develop. One degree variation in final boiling temperature can make the difference between a sticky, cloudy sweet and a clear, dry one. The order of addition of ingredients given in the recipe must be strictly adhered to, since each contributes towards a specific action on the boiling. For this reason, acid used to enhance fruit flavours is usually added at the end of the cooking time to prevent inversion of the sucrose which would vary the texture and keeping qualities of the product. Colouring and flavouring agents can be affected by high temperature and are therefore added when the syrup is cooling.

TYPES OF COOKERS

There is a variety of methods of boiling syrup and the simplest use open pans of copper, stainless steel or aluminium. Open stoves burning solid fuel, gas or oil are used for cooking and the pans are set in large openings on top of the stoves. The boiling syrup may be stirred by hand with a wooden spatula but mechanical stirrers are necessary for larger quantities. These stirrers must be capable of two speeds for toffee manufacture, the slow speed for the pre-cooking emulsifying action and the fast speed during the heating period to prevent burning and to maintain the emulsion.

Steam jacketed pans provide a uniformly distributed source of heat for boiling low temperature sugar syrups. These pans have an outer jacket welded on to the inner lining, leaving a gap through which steam under low pressure (60—100 psi) can be passed. If a supply of steam is not available self-generating steam pans may be obtained, in which the steam is made in a gas heated pressure jacket surrounding the cooking pan. High pressure steam (150 psi) must be used to obtain the temperatures required by high boilings. The syrup is heated by a coil through which steam at high pressure is passed. The steam required for all manufacturing purposes in models B and C of this report is supplied by oil-fired boilers.

When a boiling sugar solution is held under vacuum, the water content of the syrup is rapidly reduced without raising the temperature and this fact is used in vacuum cooking to overcome some of the problems associated with the high temperatures and long boiling times in sweet manufacture. Batch vacuum cookers are recommended for use in the manufacture of both high boiled sweets and toffees. The ingredients are heated in a pre-melting pan to a temperature just below that at which spoilage might take place. The pan is connected to the vacuum cooker and when the required temperature is reached, the connecting valve is slowly opened allowing the boiling syrup to enter the vacuum chamber in a fine spray. The vacuum applied to the syrup reduces the water content to a satisfactory level: the cooker is then allowed to return to atmospheric pressure and the syrup is drawn off for processing. The plant is then ready to receive a new batch of ingredients for boiling and reducing under vacuum.

Continuous cookers are completely automatic machines which are fed from hoppers containing the ingredients; using steam heat and electric power, they produce a continuous flow of cooked sugar syrup in quantities from a ton an hour upwards. The cookers are connected in series with machines which can process the syrup automatically right through to the stage of packaging the final sweet product. The large investment involved in equipping a factory with these automatic lines of manufacture renders them suitable only for outputs well in excess of forty tons a week, and so they are outside the scope of this report.

FORMING THE SWEET

When the syrup has reached the correct temperature and water content, it is poured out of the cooking vessel onto a cold table to cool. In open pan cooking, small batches can be carried by hand to the tables, but in all other cases arrangements must be made to tap off the syrup into receiving pans which can be carried by hand or trolley to the tables.

High boiled sweets can have a variety of finished appearances according to the degree of clarity of the sugar mass. Great care has to be exercised in the handling of the plastic sugar to prevent crystallization if clear drops are being made. The simplest method of making drops is to feed a long strip of plastic sugar through a pair of drop rollers, the dies of which combined to mould the sweet, then part to allow it to drop out as the rollers turn. The numbers of sweets formed at a time depend on the width of the rollers and the number of moulds engraved on them. The rollers can be hand or power operated and are available in a wide variety of designs, which are readily interchangeable.

A greater output of formed sweets is obtained by the use of a series of machines which are linked together: a batch roller, rope former, sizer and sweet moulder. The batch roller contains a set of revolving cone-shaped heated rollers on which a batch of plastic sugar is placed to shape it into a long roll while the end is being drawn out through the rope former and sizer. It emerges as a continuous rope which is fed into the rotating dies of the moulder which form the sweets. These are ejected onto the moving belts which carry them away to cool.

Some sweet finishes require the sugar mass to be aerated so that fine crystals form, giving it a satin sheen: for this purpose the batch is laid over the arms of a rotating sugar pulling machine and the loop formed is stretched and folded automatically until the required texture is obtained. If the sweets are to be filled, the filling is prepared separately and may then be enclosed within the sweet covering by hand folding followed by shaping into a rope on a heated batch roller: rocks and filled satins are made in this manner. Large quantities of filling may be handled by using a batch centre filler which feeds the filling continuously into the centre of the batch while it is being shaped in the batch roller.

Low boiled sweets and toffees can be made using variations on the methods outlined for manufacturing high boiled sweets. The simplest method of forming toffee is to pour it into a rectangular shape on a cold table and when cool to cut it by hand or machine into squares or bars for subsequent wrapping. Toffees are also formed by feeding a bar of plastic toffee through a drop roller machine which cuts it into continuous narrow strips which may then be cut into small pieces with a hand operated rotary caramel cutter. For higher outputs, the toffee is handled mechanically on a linked series of batch roller, rope former and sizer followed by a cut and wrap machine which delivers the wrapped toffee at speeds of 300 or more pieces a minute.

FINISHING PROCESSES, WRAPPING AND PACKAGING

After the sweets are shaped, they are cooled somewhat before further finishing or wrapping. In the simplest method, sweets made on a drop roller may be dusted lightly with confectioner's flour and left to cool on open tables in a draught of air blown over them by a fan. The cooled sweets are shaken in a sieve to remove connecting links of sugar and then may be packed in polythene bags or jars in weighed quantities. High boiled sweets can be given a sugar coating which renders them very resistant to moist conditions. They are turned in a slowly rotating pan together with sufficient syrup to coat them, then fine sugar is added to cover the surfaces and they are taken out to cool and pack.

When sweets are being produced continuously from lines of automatic machines they are usually carried away from the forming machines on conveyor belts in a cooling draught of air, which is designed to reduce their temperature to about 95°F (35°C) when they are ready for wrapping. Sweets are delivered in a chute to the wrapping machine where a strip of waxed paper, foil or cellulose film is cut and wrapped around the individual sweet which is sealed by twisting or crimping the ends of the wrapping strip. An infra-red lamp is fitted over the cutting and wrapping surfaces to help protect the sweets from adverse damp conditions which can cause stickiness. Wrapped sweets are ejected from the machine at rates between 160 and 500 pieces a minute and are conveyed to the packing area to be packed into suitable containers ready for storage and delivery to the retailers. Large screw topped glass jars are widely used to store sweets in, but these present problems in collecting and washing the jars for re-use, problems which can be eliminated by the use of thick polythene bags with simple wire twist closures. If bottles are used, up to 1000 a week can be washed by hand; for larger numbers a small washing tank is necessary until quantities of over 5000 a week are being handled, when a bottle washing machine becomes economic.

AIR TEMPERATURE AND HUMIDITY CONTROL

The ideal air conditions for cooling high and low boiled sweets are for a temperature of 68°F (20°C) and a relative humidity of 45 per cent. Toffees contain a higher percentage of moisture and so will withstand relative humidities of 55–75 per cent at this temperature. In these conditions, the product will have a negligible tendency either to take up or to lose moisture and so it remains in a stable condition. These ideal conditions should be borne in mind when considering arrangements for handling the sweets after they have been formed and before they are protected by individual or bulk wrapping. Sweets are formed in moulds while they are still warm and plastic: they have little tendency to absorb water when they are at a temperature above that of their surroundings and therefore it is desirable to wrap sweets as soon as possible after forming. This is easily arranged when automatic wrapping machines are incorporated in the manufacturing line but it is not always possible when there are further finishing processes to be done before hand weighing and bulk packing. It is usual for the forming and wrapping rooms to be controlled in temperature and humidity: this can be done economically without full air conditioning if the relevant areas requiring control are separated from sources of heat and steam and from areas which do not require control. The cooking area should have an extraction fan and air circulating system but requires no special conditions. The cooling area is obviously better separated from the cooking area but it is vital that the sweet forming area should be free from steam so that the moulded sweets can cool in conditions approaching ideal.

The humidity of a small room can be reduced quite inexpensively by installing a dehumidifier which removes moisture from the surrounding air. The temperature and humidity of a room can be lowered by installing a simple cooling device in the external wall: the air entering the room is cooled by a refrigerating coil which also condenses some of the moisture from the warm air. The cool dried air is blown into the room and warm air extracted. The number of cooling units required depends on the volume of the room and the particular air conditions of the surroundings: advice must be sought from manufacturers who specialise in air conditioning. Full air conditioning is an extremely costly investment and requires quite extensive arrangements in the building to ventilate and isolate the various areas requiring conditioning, quite apart from the cost of the actual air conditioning plant. This would only be undertaken for a much larger scale of manufacture than is being considered here.

WRAPPING MATERIALS AND CONTAINERS

Wrapping materials should protect the sweet from moisture and keep the product clean during subsequent handling. The most appropriate containers are strong

plastic bags large enough to hold five pounds of sweets and closed with a wire twist. These can be packed in cardboard cartons for storage and transport. Plastic bags are readily available in most parts of the world and may be bought ready made or in continuous tube form, when a simple end-sealing machine is used to make up the bags as required. The traditional large screw topped sweet jar has many disadvantages in use in developing countries. The jars are expensive to obtain, must be ordered in very great bulk to obtain a reasonable price, often a year's supply in advance for remoter areas, which presents great storage problems. They must be returnable and must be washed before use. The transport of large glass containers is cumbersome and breakage risk is high. In recent years, there has been an increased use of small sealed plastic bags which are filled and sealed automatically, are easy to handle, attractive to display and may be sold direct to the customer in ¼lb and ½lb units. Plastic bags do not require any special storage conditions. The reels of film for machine wrapping must be of a reliable and consistent quality and will usually be imported. Cellulose film is recommended since it can withstand wider variations in storage conditions than waxed paper. It should be stored in the area where temperature and humidity are controlled, probably this will be the wrapping room itself. This precaution is to ensure that the film works smoothly in the wrapping process. It has no special storage requirements when wrapped around the sweets.

STORAGE OF SWEETS

When properly wrapped and contained in relatively airtight jars, bags or boxes, the storage of high and low boiled sweets presents few problems: it is not necessary to condition the air during storage. The containers are usually stored on open shelving in a well ventilated warehouse with an easy access to the loading bays for delivery trucks. The amount stored will be in relation to the rate at which particular varieties are produced compared with the size of the orders for them and may average the factory's total output for one month. When the storage of raw materials is also taken into account, it will be realised that warehouse space is a major consideration in the planning of a smoothly flowing production line.

QUALITY CONTROL AND ROUTINE MAINTENANCE

Quality control in the manufacture of high boiled sweets and toffees is maintained by rigid formulation of the recipes and exact processing methods. Workers involved in production must be trained to work to exact instructions. A process sheet containing every detail of his job should be given to the individual worker, including references to safety hazards or points requiring special precautions. Exact process methods and well trained workers should result in a product of the required standard. Laboratory testing is not considered necessary for these scales of production.

Absolute cleanliness is essential in every stage of food manufacture to prevent the growth of mould or bacteria particularly in conditions of high temperature and humidity. It is recommended that production workers be responsible for the cleaning operations of their own machines and working areas to ensure their involvement in good standards of hygiene. Fifteen minutes a day is sufficient for the routine cleaning of boiling pans, work surfaces, tools and for floor-sweeping. Excessive moisture is undesirable except in the boiling rooms so floors should be washed only at the end of the week's work. One hour a week is sufficient for the routine cleaning of machinery and floor washing. A monthly routine for washing part of the walls and surrounding areas ensures that the factory is systematically cleaned throughout the year.

SCRAP UTILISATION

There will always be a proportion of waste product in the manufacture of sweets in addition to the malformed and badly wrapped ones which are unsuitable for sale. The moulded shapes are formed in continuous strips and the connecting links must be removed by trimming and sieving. A well designed programme for scrap utilisation is essential since discarded waste is discarded profit. All waste products should be re-cycled whenever possible. Scrap from high boiled sweets may have crystallized and therefore should not be added directly to fresh boilings because of the danger of inducing further unwanted crystal formation. Suitable scrap may be completely dissolved in the minimum quantity of water and a measured proportion incorporated into the formulation of a new batch of the same type. The remaining scrap which by reason of colour or acidity is unsuitable for use in this way, can be used to make a low temperature boiling which is suitable as a filling for high boiled sweets.

RAW MATERIALS

Sugar

There are several grades of refined white sugar or sucrose, differing in the amount and type of minute quantities of impurities present. A particular grade may be excellently suited for one type of sugar confection but quite unsuitable for another. Lower grade sugar may be contaminated with strands of sacking and foreign particles and may need sieving before use. A sugar chemist should be asked to advise on the grade of sugar suitable for the intended range of products. Sugar can be delivered in bulk by tanker and pumped into hoppers for storage or it may be delivered in smaller quantities in hundredweight sacks. There are no unusual storage problems. It is possible to buy a blended sucrose and glucose syrup but this is only suitable for the large throughput of automatic production lines.

Glucose syrup

This clear viscous liquid may be delivered in bulk by tanker and pumped into storage tanks or it may be delivered in drums. The syrup must be kept at a steady temperature, and in cold climates a small heating coil is incorporated in the glucose tank to keep the syrup free-flowing. On the other hand too much heat in storage causes the syrup to develop a brown colour which may spoil the product.

Glucose syrup is classified according to its dextrose or reducing sugar content, measured by dextrose equivalent, DE, with ratings given according to strength thus:

low conversion glucose	28–37 DE
regular conversion glucose	38–47 DE
intermediate conversion glucose	48–57 DE
high conversion glucose	58–68 DE

Under normal conditions of climate, the regular conversion glucose 40–43 DE is used; however, for very humid conditions, low conversion glucose, 34 DE, is recommended for the manufacture of a sweet more resistant to moisture. In recent years, it has been shown that sweets made with glucose containing a high proportion of maltose (high maltose 42 DE) have five times the shelf life of those made with normal glucose, due to their reduced tendency to attract moisture from the atmosphere. In spite of these considerations, there may be no choice of glucose available, and the recipe must be adapted in other ways to take account of the climate

Water

It is extremely important that the water used in sugar boiling has known characteristics of acidity or alkalinity and mineral content, since these influence the rate of inversion during boiling, the flavour and the colour of the product. Ideally the water should have a neutral reaction, being neither acid nor alkaline. This can be obtained by testing the water initially and using a simple corrective to bring it back to a neutral state.

Confectionery fats

A range of vegetable fats are available and those made from hydrogenated palm kernel oil are recommended as being stable under extreme conditions of heat and high humidity. This can be obtained as a hard, white fat with a melting point of around 100°F (38°C) giving a toffee which keeps its shape well in storage and has a good chewiness when eaten. The fat must be stored in a well-ventilated place away from the light, at a temperature of at least five degrees fahrenheit (three degrees centigrade) below its melting point.

Emulsifying agents

Those in common use in the manufacture of toffee are soya, lecithin and glyceryl monostearate, GMS. They are used in very small quantities, proportionate to the amount of fat required to be emulsified, and will probably be imported.

Milk products

Sweetened condensed milk, full cream or skimmed, is a common ingredient of toffee and grained fudge giving it a creamy flavour. It is stored in air-tight containers and requires temperatures below 60°F (16°C) for long storage.

Dried skim milk powder can be used as a substitute for condensed milk, being widely available and easy to store. It is reconstituted in batches and boiled with sugar and glucose to make a product identical to commercial skimmed condensed milk. The reconstituted milk must not be stored since it is liable to rapid deterioration by bacterial action. Very careful cleansing of all utensils is necessary to keep them free from infection and mould.

Acids

Citric, tartaric and malic acids are those most generally used in sweet manufacture, usually to enhance the added fruit flavours. Granulated acids are preferred to the powdered form because they are easier to distribute in the sugar mass.

Flavouring agents

Essential oils are natural products which give a distinctive flavour to foodstuffs, but they are expensive and are usually replaced by synthetic flavours. The manufacturer of synthetic flavours will need to know the type of sweets intended and conditions of their manufacture before he can advise on suitable flavours and methods for their use. Some developing countries will need to import flavouring and colouring agents and a considerable saving in cost can be made by bulk buying. The small manufacturer must expect to store flavouring agents for several months under cool dark conditions.

Colouring agents

These have to be chosen from a list of permitted confectionery colours for the country concerned. They can be obtained as powders which have to be made up to an accurate solution in water and added to the batch in small measured quantities. Colour sticks are made in which a fixed percentage of colour is held in a gelatine base and the whole stick is added to the batch of sugar; this eliminates the likelihood of error in weighing and the disadvantage of adding water to a boiled batch. The same considerations of bulk buying apply here as for flavouring agents.

Chapter 3

Analysis of models

HOW TO USE THE MODELS

The cost tables in Appendix 2 set out cost models for the sweet manufacturing process and illustrate the use of cost information to obtain conclusions on the viability of schemes for investment. All tables are given for the three scales of output, models A, B and C (50 tons, 250 tons and 1,000 tons per annum respectively). The main conclusions may be drawn from Table 1 which summarises the total investments, operating costs and returns from the project. The remaining tables show, in detail, the information from which Table 1 is calculated. The tables should be studied together with the notes in Appendix 1 which give a row by row interpretation of any derivations that are not obvious. Tables 3, 4 and 5 detail the type and cost of machinery and equipment for the three models. Tables 6 and 7 detail the quantities and costs of the inputs. Table 8 summarises the labour requirements and wage costs. Table 2 shows the steps involved in calculating rates of return when initial and annual tax allowances are taken into account. This table also summarises the rates of return obtained on the assumption that second hand machinery is used where appropriate. It is hoped that the reader will be able to use the model outline in the eight tables as a basis for costing exercises, using information on local costs and current quotations for machinery prices which may be affected by inflation.

In order to provide a realistic framework, the models have been calculated against a background of costs for West Africa, using simplifying assumptions in order that the general method may remain clear. The sales revenue has been estimated from the current 1971 average retail price for boiled sweets and toffees in West Africa. Distribution costs are very high in developing countries and therefore a margin of 40 per cent of the retail sales price has been allowed for these in the calculation of the sales revenue. The probability that most of the workers involved in the manufacturing process will be unfamiliar with factory methods will tend to result in a relatively low efficiency of output. Therefore throughout the calculations, it has been assumed that output will be at a level of 80 per cent of the amount specified by the manufacturers.

There are several ways of assessing the viability of an investment in a business venture and some of these are discussed in this chapter. The answers obtained vary according to the way in which profit and invested capital are defined, particularly with regard to depreciation and taxation. The basic assumptions of market demand and type of product desired should be carefully examined before using any model as it stands. Sufficient detail has been included to suggest ways in which they may be modified. Some aspects of the choice of scale are considered in Chapter 4.

RATE OF RETURN ON CAPITAL

This method of assessing profitability compares the amount of annual profits with the total investment. The formula used to calculate rate of return is:

Rate of return on capital = Profit expressed as percentage of total investment. Rates of return have been calculated in two different ways in Table 1, Appendix 2: the first (row 26) was calculated using a figure for gross profit obtained after allowance had been made for depreciation but before tax: the second rate of return (row 27) was calculated using a figure for gross profit obtained after all adjustments for tax and depreciation had been made. The effect of tax and tax free allowances on both profit and total investment is such as to reduce the rate of return by about a third and demonstrates the importance of their inclusion in an estimation of profitability.

Table (a) below shows the effect on rates of return if certain of the factors concerned are varied.

Table (a)

Variations in rate return on capital including depreciation before tax

	Scale A	Scale B percentages	Scale C
Rate of return from Table 1 row 26	41	50	74
Rate of return if:			
ingredients costs doubled	−20	2	12
supplies costs doubled	36	39	56
labour costs doubled	−11	36	59
output halved	−16	9	24
addition of one toffee cut-and-wrap machine with ancillary equipment	n.a.	28	64
second hand machinery used (data from Table 3)	50	84	90

The changes in rates of return given in Table (a) show clearly that the profitability of the three scales A, B and C are affected quite differently according to which cost is being altered. Profits of all three scales are lessened by doubling the costs of ingredients; scale A shows a loss and scales B and C show negligible profits. Halving the output causes a similar effect with scale A showing a loss, scale B a negligible profit and scale C a very reduced profit. If labour costs are doubled, scale A shows a loss but scales B and C are less affected and can still show a profit.

These results are better understood if the cost structure of the three models is examined. Table (b) which clarifies this structure, shows the variable costs taken from Table 1, rows 8–17, Appendix 2, expressed as percentages of the annual operating costs. It also shows the effect on these percentages of increasing particular costs.

With a knowledge of the percentage cost structure of the models, the variation in effect upon rates of return by increasing costs is better understood: increasing those costs which initially form a large percentage of total costs, will increase costs and decrease profits to a greater extent than will those which initially form a small percentage of total costs.

The cost of adding one toffee cut-and-wrap machine with appropriate adjustment to ancillary equipment, has been calculated. Scale A has too small an output to warrant the use of a machine, but a machine could replace the drop roller for the manufacture of toffee in both scales B and C, giving the advantage of a higher quality wrapped product. Since it would not be fully utilised in scale B and the resulting 28 per cent rate of return on capital is comparatively low, the purchase of a cut-and-wrap machine for scale B would only be justified as part of an

Table (b)

Variable costs as percentages of total annual operating costs

Costs from Table 1, Appendix 2	Scale A	Scale B	Scale C
Ingredients:			
(a) basic cost row 8	42	50	54
(b) doubled cost row 8	57	65	67
Supplies:			
(a) basic cost row 9	3	11	15
(b) doubled cost row 9	6	20	26
Power and fuel row 10	3	6	4
Labour:			
(a) basic cost row 11	35	15	12
(b) doubled cost row 11	51	26	21
Transport row 12	3	1	1
Other rows 13–16	14	17	14
Total annual operating costs row 17	100	100	100
Working capital row 7	16	16	16
Excise duty row 18	10	12	13

expansion programme. Scale C with its larger output appears able to absorb the extra costs and shows a lowered but adequate rate of return, 64 per cent. Table (a) shows the higher rates of return obtained when suitable second hand machinery is installed wherever possible. This will give no saving in running costs and there may be a greater chance of breakdown and obsolescence. These factors should be weighed against the short term advantage of a lower capital investment in used machinery.

CAPITAL RECOVERY PERIOD

The profitability of an investment may be roughly estimated by calculating the time taken to recoup the investment from annual profits, assuming all allowances have been made for tax and depreciation.

$$\text{Capital recovery period} = \frac{\text{Total investment}}{\text{net profit}}$$

All three models show a recovery period of three years or less for the basic conditions of cost and output, see Table 2, row 12, Appendix 2. This represents an acceptable return for loans advanced on the purchase of machinery. Total investment can be reduced by the purchase of second hand machinery leading to economies in the recovery period of about half a year for each model, see Table 2, row 12.

PROFIT MARGIN

A profit margin defines the limits within which costs and revenue can move relative to each other and still allow a profit to be made. It can be defined as the extent to which costs can rise until they are just equal to revenue, or the extent by which revenue can fall until it just covers costs. In both these extreme cases there are no profits. Table (c) below shows the profit margins for the three models which are calculated from Table 1, Appendix 2. The margin is equated with the profit, row 25, and is expressed either as a percentage of total costs, row 22, or of sales revenue, row 23. Consideration of the profit margin available for a given set of conditions gives some idea of how resilient a project would be in adverse circumstances in the future.

Table (c) also shows the extent to which individual costs can rise until costs are just balanced by revenue. Beyond this point a loss would be made. The models

Table (c)

Limits of cost and revenue changes to maintain profitability

	Scale A	Scale B	Scale C
	Change as percentage of original		
Profit margins:			
(a) limit of rise in total costs	+ 27	+ 49	+ 59
(b) limit of fall in sales revenue	- 21	- 33	- 37
Limits of rise in individual costs for			
(a) ingredients	+ 67	+ 105	+ 119
(b) supplies	+ 930	+ 463	+ 415
(c) labour	+ 79	+ 349	+ 549

are all sensitive to rises in ingredient costs and losses would be made in each case if the prices rose by a little more than 100 per cent. The models are less sensitive to labour costs and only A would result in a loss if costs rose by 80 per cent. Supplies represent a small proportion of total costs and the models can absorb considerable increases in these costs without unduly affecting the profits.

DISCOUNTED CASH FLOW

The calculation of rates of return on capital can give misleading results when there are several alternative investments to be considered or where there is likely to be a variation in outlay or income in different years in the life of the investment. For these purposes the technique of discounted cash flow is used. In this method, the difference between the cash inflows and outflows over the life of the project is calculated and each is discounted by an appropriate rate and totalled to arrive at the net present value. The appropriate rate is that which represents an acceptable return on capital in the business market. If the net present value is positive the investment is viable and a comparison between alternative investments can be made to find the best value. The technique has not been used in this analysis since there are not alternative investments to compare and the models show good returns by conventional methods.

ECONOMIES OF SCALE

When the output of a firm is increased by the use of a larger plant, the cost of producing each unit of output usually falls. These economies of scale are demonstrated in the three models and some aspects are shown in Table (d) below:

Table (d)

Aspects of economies of scale

	£ sterling 1970		
	Scale A	Scale B	Scale C
Unit cost per lb product from Table 1, row 17	£0.099	£0.081	£0.076
Capital invested per head of total work force, rounded to £'000	£1,000	£3,000	£3,000
Direct labour per ton of product per week	5	3	2.75

The cost of producing one pound of sweets decreases as the scale of production increases from A through B to C. This is because the costs of machinery, manpower and other overheads do not increase proportionately with the increase in output. More capital per head of work force is invested in automatic production methods as the scale of production increases, leading to a decrease in the ratio of direct labour to output. The ratio of labour to output per ton per week is reduced from five in scale A where all processes are hand operated to below three

in scale C where most processes are semi-automatic. The availability of economies of scale will depend to some extent on the relative costs of machinery and labour so local wage rates will exert a powerful influence on the choice of machinery and output. In Britain where wage rates are high, a labour : output ratio of 2 : 1 is considered ideal for small to medium scale sweet manufacture. This cannot be attained unless machines are used for forming and wrapping all sweets and this is further discussed in Chapter 4.

The improvement in quality of sweets due to greater automation of forming and wrapping in scales B and C should command a higher price than the handmade unwrapped sweets of scale A but in this report the costs have been calculated using only one average sales price.

Chapter 4

Choice of scale

The first step to be taken when considering investment in a manufacturing process, is to estimate the size of the market open to the product so that production can take place at an appropriate scale. The market for sweets, chocolates and toffees is being increasingly taken over by a few international firms who can afford to install the most sophisticated automatic machinery making sweets at ten times the speed of traditional methods, in a continuous process, with raw materials fed in at one end of the line and wrapped, packaged sweets emerging at the other. These products of automatic lines are of a uniformly high standard and backed up by extensive marketing represent a serious challenge to any small aspiring competitor. The investor must try to take advantage of his regional knowledge of local preferences, his personal contact with local outlets and his ability to provide a wide variety of sweets not able to be mass-produced. The economic price at which the manufacturer can sell a product and the acceptable price at which the local consumer will buy the product, are the two important factors which must be equated if a business is to be profitable. The acceptable buying price can be found by careful investigation of the income levels and buying habits of the local consumers. One of the purposes of this report is to enable a potential investor to estimate the economic selling price and several methods of estimation are discussed in Chapter 3.

When the market for sugar confectionery in a developing area has been assessed and judged adequate for the establishment of a small business, it is suggested that production should initially be limited to that quantity which one sugar boiler and an unskilled assistant could make on their own, using an open fire and a few boiling pans: somewhere between five hundredweights to one ton a week, depending on the size of the market outlets. They should aim to reach break-even point on their investment in plant and buildings in the shortest possible time, before considering any expansion. For this output, an expert in confectionery production recommends that not more than twelve variations in colour, taste or texture should be attempted. Sufficient variety could be found among the simpler types of high and low boiled sweets. This small-scale venture should be used to obtain the skill and experience in local conditions necessary for an expanding business.

By the time that output has been raised to one ton a day, it would be expected that a small manufacturer would be equipped with labour-saving plant at all stages of manufacture as in Model A, although the product might be hand-fed at each stage. To reach outputs of four tons a day, while still keeping labour costs low enough to make a product which can compete in price with those from large automated firms, a considerable investment will have to be made in vacuum cookers, large capacity cookers with two-speed mixers, semi-automatic lines for rolling, moulding and cooling the sweets and enough machines to wrap those varieties requiring this, allowing one machine for each 0.8 ton produced daily. In calculating these quantities, consideration should be given to the fact that a wrapping machine set to handle a certain shape and type of sweet can take from fifteen minutes to three hours to alter it to suit another. Even if adjustment is possible, it is undesirable to make frequent alterations since they increase the risk of faults and disrupt the manufacturing process.

In Great Britain, the recommended ratio of manpower to product is traditionally two workers required for each ton of confectionery produced per week. This figure is based on the use of skilled labour and mechanical handling methods. It must be modified when unskilled labour and hand finishing methods are employed. For example, several small British firms producing three to five tons per week are known to have manpower ratios of three to four workers per ton per week due to the number of unskilled workers required for hand-packing. This suggests that the ratios of 5, 3 and 2.75 workers per ton per week obtained in the three models may be acceptable in countries that have low wage rates. A crucial factor in the manpower ratio is the decision made on the degree of wrapping required by the sweets. Although automatic wrapping machines cut labour requirements, they are a relatively large investment for a small firm, representing more than three times the capital investment in plant for model A and they require an output over half a ton a day for efficient utilisation. They require a high degree of standardisation of product and working conditions and need skilled maintenance. For all these reasons, as long as labour rates are low and output is small, recipes can be adjusted to produce sweets which do not require individual wrapping but are weighed by hand into large polythene bags. When conditions justify investment in a wrapping machine, a second-hand low-speed machine can be bought for a few hundred pounds. Many forty year-old machines are still working steadily, are simple to maintain and are readily available on the second-hand market. The modern trend towards fewer larger units of manufacture using completely automatic lines has made available a wide range of second-hand traditional sugar confectionery machinery. Some of the smaller machines are no longer manufactured in Britain but are in plentiful supply second-hand. Although there tends to be a risk involved in ordering second-hand machinery, the cost of new machinery is often so prohibitive that most small manufacturers in developing countries rely initially on obtaining second-hand units through recommended dealers, when prices may be about half those for new machinery when packing and freight costs are included. Quotations for the machinery given in the models were for prices ruling in 1970. Costs are increasing due to inflation and fresh quotations should be obtained for greater accuracy. A list of manufacturers and suppliers is given in Appendix 3. The type of plant for each scale was chosen on advice from machinery and confectionery manufacturers as being suitable for the manufacture of a typical range of sweets. Confectionery manufacturers use such a variety of acceptable methods that a wide choice of equipment is possible. Further advice is available from the sources of information listed in Appendix 3.

The smooth and uninterrupted flow of production is dependent upon the product having consistent characteristics. This consistency can only be maintained by the use of exact specifications for both raw materials and method. The major ingredients are sugar, glucose, fat and milk and the quality of any locally available inputs should be checked by confectionery experts when considering the feasibility of establishing a plant for the manufacture of high boiled sweets and toffees. It is likely that the other minor ingredients, colouring and flavouring agents, acids and emulsifiers will have to be imported together with reels of cellulose film wrapping paper since they are all specialist confectionery products. When considering the feasibility of an investment in confectionery production, due weight should be given to the availability of the necessary skilled labour as well as to the availability of raw materials and plant. Local conditions can vary widely in developing countries and it is always possible that unusually high import tariffs or distribution costs, for example, could make production uneconomic in a particular area.

A great deal of help in compiling this report has been given by manufacturers and suppliers of materials and machinery. They stress the importance of expert advice on choice of methods and welcome enquiries from overseas. A list of names and addresses is appended for sources of information. Advice on overseas problems is also given by experts in the trade journals which should be consulted in the planning stages. Experience in the field and expert advice are essential since this report is intended only as an introduction to a limited field of confectionery manufacture.

Appendix 1

Operational data and notes on tables

The fundamental assumptions underlying the cost models are as follows:

1. The plant operates on one eight hour shift for five days a week, 250 days per year.
2. The operating efficiency is 80 per cent of the maximum throughput specified by machinery manufacturers and conforms to the opinion of experienced sugar boilers.
3. The models are set in a West African context and where possible factor costs have been locally obtained. Other costs have been adjusted suitably. All costs are given in £ sterling.
4. The prices quoted were those prevailing in 1970. Subsequent inflation will have affected machinery prices in particular and new quotations will be necessary to reflect the current situation.

TABLE 1: CAPITAL AND ANNUAL OPERATING COSTS, SALES AND RETURNS

The figures given in Table 1 can be derived for the most part from information given in Tables 2–8. Further explanations and supplementary tables are given below:

Row 2 – Buildings:

Scale A – 1,000 sq ft at £2.92 per sq ft
Scale B – 3,500 sq ft at £2.92 per sq ft
Scale C – 12,000 sq ft at £3.5 per sq ft

It is assumed that model C is sited in the vicinity of a large town where a higher building rate would apply. Land is rented and included in miscellaneous items, row 14.

Row 3 – Plant: if spares excluded A = £1,700, B = £26,700, C = £69,000 adjusted figure required for calculation of repairs and maintenance, row 13.

Row 4 – Installation: 10 per cent fob prices of plant

Row 5 – Vehicles: see transport row 12

Row 7 – Working capital: two month's running costs

Row 12 – Transport: costs were obtained from local sources and are based on the following assumptions:

Scale A – one small van costing £1,200 travels an average distance of 30 miles per day collecting some supplies and delivering 0.25 tons of sweets per day to retailers. The van uses one gallon of fuel per 25 miles at £0.23 per gallon.

Scale B — one 1½ ton truck costing £1,800 travels an average distance of 50 miles per day collecting some supplies and delivering one ton of sweets per day to retailers and wholesale depots. The truck uses one gallon of fuel per 20 miles at £0.23 per gallon.

Scale C — two 3 ton trucks costing altogether £4,700 travel on average a total distance of 200 miles per day delivering 4 tons of sweets per day to wholesale depots which supply a wide area of the country. The trucks use one gallon of fuel per 15 miles at £0.23 per gallon.

Annual transport costs including fuel, insurance, tax, maintenance and tyres replacement:

Scale A — £300: Scale B — £400: Scale C — £1,500.

Row 13 — Repairs and maintenance: 5 per cent of initial cost of buildings plus plant excluding spares, see note to row 2.

Row 14 — Miscellaneous: includes an estimated figure to cover office expenses and rent for land and insurance.

Office and other expenses A = £100, B = £300, C = £600.

Rent for land: row 1 Table 6 and page 25

Insurance: 0.25 per cent of value of buildings, row 4
0.45 per cent of value of plant, row 2
0.75 per cent of value of stock, two months ingredients and supplies, one sixth of rows 8–9.

Row 18 — Excise duty: £21.8 per ton of product

Row 21 — Depreciation: 10 per cent of plant row 2; 5 per cent of buildings row 4, $33\frac{1}{3}$ per cent of vehicles row 5.

Row 23 — Sales revenue: has been based on 60 per cent of the current retail price of £0.243 per lb obtained for this type of confectionery in some parts of West Africa, where sweets are often sold individually in the local shops. Distribution costs can be very high in developing countries and a 40 per cent allowance has been made for this reason.
Sales A = 50 tons, B = 250 tons, C = 1,000 tons.

TABLE 2: RATE OF RETURN ON CAPITAL INCLUDING TAX AND ALLOWANCES FOR NEW AND USED MACHINERY

This table is developed from Table 1 and the figures for new machinery are shown in columns b, d and f. The figures for second-hand machinery shown in columns c, e and g, have been obtained similarly. The estimated total outlays on second-hand plant cif West Africa were as follows:

A — £700; B — £12,200; C — £30,400

The prices for second-hand confectionery machinery and equipment cif West Africa quoted by suppliers, average half the new ex-factory price in Britain, but these obviously vary with the condition and type of the equipment in question. For safety reasons, steam boilers are not recommended to be bought second-hand.

Row 2 — Annual allowances: tax-free allowances for buildings, 5 per cent total cost; plant and installation, 10 per cent total cost. Table 1, rows 2, 3 and 4.

Row 4 — Company tax: 40 per cent of taxable gross profit.

Row 9 – Initial allowances: a tax-free allowance is given for the first year only on investment in buildings of 10 per cent total cost and on investment in plant and installation of 15 per cent total cost. The tax rebate on these allowances, 40 per cent of the total tax-free allowance on buildings, plant and installation, is subtracted from the total investment to give an adjusted figure for investment, used when calculating rates of return on capital, after tax. These allowances are shown in Table (e) below:

Table (e)

Tax rebate on initial allowances

£'000 sterling 1970

	Scale A		Scale B		Scale C	
	new m/c	used m/c	new m/c	used m/c	new m/c	used m/c
40 per cent tax rebate on:						
(a) 10 per cent of cost of building	0.1	0.1	0.4	0.4	1.7	1.7
(b) 15 per cent of cost of plant and installation	0.1	0.05	1.8	0.8	4.6	2.0
Total tax rebate	0.2	0.2	2.2	1.2	6.3	3.7

Row 11 – Rate of return on capital: these results are discussed in Chapter 3, pages 16–17.

TABLES 3, 4 AND 5: COST OF EQUIPMENT FOR SCALES A, B AND C

Quotations given in these tables are for prices ruling in 1970. Insurance and freight are calculated as being 10 per cent of the price fob British port. Duty is added at 5 per cent cif price. An allowance for spares of 3–5 per cent of the cost of machinery is recommended by the manufacturers. The calculation of kVA rating is explained below in the notes to Table 6, row 3. The choice of of machinery is discussed in Chapter 4, pages 21–22.

TABLE 6: LAND, FLOORSPACE, SERVICES, VEHICLES, LABOUR REQUIREMENTS AND COSTS FOR SCALES A, B AND C

Row 1 – Land rent: assume area of land required to be double the area of land occupied by the building. The rents reflect the variation in land values between rural and more urban sites.

Row 2 – Floorspace: it is assumed that model C is sited in the vicinity of a large town where a higher building rate would apply. Building floor areas were estimated from the space requirements of the machinery, in consultation with an expert in confectionery production.

Row 3 – Electricity: the standing charge is calculated from the maximum possible power demand from the plant installed, called kVA rating, and is independent of actual running time. It is charged on a monthly basis. Using the relationship:

1 horse power (hp) = 0.746 kilowatt (kW)

and kVA = kW

the standing charge can be calculated from the total power ratings given in Appendix 2, Tables 3, 4 and 5. The running charge is calculated from the total number of kilowatt-hours, kWh, used by the plant. For this type of machinery the following equation can be used:

$$kWh = kW \times h$$

The running time for each machine was estimated for the required daily output using the data from Table (f) page 26 and Tables 3, 4 and 5 and allowing for 80 per cent efficiency of maximum throughput. From these data, the daily power requirements in kWh was calculated for each machine.

Row 4 – Fuel oil: stove A 2 gal per hr per 3 hr day
steam boiler B 3.6 gal per hr per 9 hr day
steam boiler C 5.4 gal per hr per 9 hr day

Row 5 – Water: estimated to include allowances for recipes, vacuum cookers, boilers and workers.

Row 6 – Vehicles: see notes to Table 1 row 12 page 23

Rows 7 and 8 – Labour: see Table 8

TABLE 7: QUANTITIES AND COSTS OF RAW MATERIALS AND SUPPLIES FOR SCALES A, B AND C

Most of the cif prices in this table have been calculated from the prices fob British port, by the addition of 10 per cent for freight and insurance. The quotations for sugar and cartons were obtained from local West African sources.

Rows 1–8 – Ingredients: The quantities are calculated from the product mix and recipes given in the following table:

Table (f)

Typical product mix and recipes for manufacture of high boiled sweets and toffees

	Scale A	Scale B	Scale C
Total output: (a) tons per year	50	250	1,000
(b) tons per 8 hour day	0.2	1	4
High boiled sweets: (a) tons per year	30	150	600
(b) tons per 8 hour day	0.12	0.6	2.4(1)
recipe as percentage of total			
(a) sugar	70	60	60
(b) glucose	30	40	40
(c) acid	1.5	1.5	1.5
(d) flavouring and colouring agents	(2)	(2)	(2)
Toffees: (a) tons per year	20	100	400
(b) tons per 8 hour day	0.08	0.4	1.6
recipe as percentage of total			
(a) sugar	30	30	30
(b) glucose	40	40	40
(c) milk product	15	15	15
(d) fat	15	15	15
(e) salt	0.5	0.5	0.5
(f) lecithin	0.1	0.1	0.1
(g) flavouring agent	(2)	(2)	(2)

footnotes: [1] this includes 0.4 ton centre filling cooked in steam pan
[2] due to wide variation in prices and concentrations, average cost of flavour and colour per ton of product is used.

Row 4 – Milk: sweetened, condensed, skimmed.
Scale A and B in 28 lb tins; scale C in 0.25 ton drums.

Rows 5 and 6 – Flavouring and colouring: due to wide variations in prices and concentrations, average cost of flavour per ton of sweet produced is taken as £2 cif West Africa and average cost of colour per ton of high boiling is taken as £0.45 cif West Africa.

Row 8 – Other ingredients: salt and lecithin for toffee manufacture: french chalk for general use to prevent sweets from sticking.
Estimated figures.

Row 9 — Plastic bags: capacity 5 lb sweets.
Cartons: capacity 30 lb sweets per carton, 75 cartons per ton. Half the cartons are returned for a second trip thus reducing requirements to 50 cartons per ton.

Row 10 — Wrapping paper: wrapping machines require on average 0.05 ton paper per ton of sweet wrapped. A — no machine, B — 1 machine, C — 4 machines.

TABLE 8: DETAILS OF PERSONNEL AND EARNINGS FOR SCALES A, B AND C

The amount of labour required was estimated from advice given by working managers in the trade. Wage rates were those current in a West African country 1970 and include an allowance for insurance contributions. The effect of increased labour costs on profits is discussed in Chapter 3, analysis of models.

The number of workers required depends on the degree of skill available and on the product chosen: if there is more handwork involved in finishing and packing, the labour ratio will increase. The manpower requirements in these models assume the minimum finishing processes and no hand wrapping of sweets or toffees.

Appendix 2

Tables

Table 1

Capital and annual operating costs, sales and returns

Operating 8 hour day, 250 days per year. Annual outputs A = 50 tons, B = 250 tons, C = 1,000 tons

Values in £'000 sterling 1970

	Projected outputs	Scale A	Scale B	Scale C	Notes
	a	b	c	d	e
1	Total investment	8.4	53.8	164.6	Sum of rows 2 to 7
2	Buildings	2.9	10.2	42.0	
3	Plant including spares	1.7	27.7	71.5	cif prices from Tables 3–5
4	Installation	0.2	2.4	6.2	
5	Vehicles	1.2	1.8	4.7	
6	Unforeseen	0.6	4.2	12.4	10% rows 2 to 5
7	Working capital	1.8	7.5	27.9	One sixth of sum of rows 8 to 15
	Annual operating costs				
8	Ingredients	4.6	22.9	91.1	Table 7
9	Supplies	0.3	5.2	26.2	Table 7
10	Power and fuel	0.3	2.8	5.9	Table 6
11	Labour (a) direct	1.6	4.4	14.5	Table 8
	(b) indirect	2.3	2.6	5.3	
12	Transport	0.3	0.4	1.5	
13	Repairs and maintenance	0.2	1.8	5.6	
14	Miscellaneous	0.2	0.6	1.8	
15	Unforeseen	1.0	4.1	15.2	10% rows 8 to 14
16	Interest on working capital	0.2	0.7	2.5	9% row 7
17	*Total annual operating costs*	11.1	45.5	169.7	Sum of rows 8 to 16
18	Excise duty	1.1	5.4	21.8	
19	Sales staff	–	–	2.9	Table 8
20	*Total annual sales costs, excl. depreciation*	12.2	50.9	194.4	Sum of rows 17 to 19
21	Depreciation	07.	3.9	10.8	
22	*Total annual sales costs incl. depreciation*	12.9	54.8	205.2	Sum of rows 20 and 21
23	*Sales revenue*	16.3	81.6	326.6	
24	Taxable gross profit excl. depreciation	4.2	30.7	132.2	Row 23 minus row 20
25	Taxable gross profit incl. depreciation	3.5	26.9	121.4	Row 23 minus row 22
26	Rate of return on capital before tax incl. depreciation	41%	50%	74%	Row 25 as % of row 1
27	Rate of return on capital after tax and all allowances	23%	31%	46%	See Table 2 row 11
28	Capital recovery period	3.0 years	2.6 years	1.9 years	See Table 2 row 12

Sources:

Appendix 1 page 23

Footnotes:

——— sub-total

nil, negligible or not applicable

Table 2

Rate of return on capital including tax and allowances, for new and used machinery

Values in £'000 sterling 1970

	a	Scale A new b	Scale A used c	Scale B new d	Scale B used e	Scale C new f	Scale C used g	Notes
1	Taxable gross profit excluding depreciation	4.2	4.3	30.7	31.7	132.2	134.7	Table 1 row 24 and notes to Table 2
2	Annual allowances	0.3	0.2	3.5	1.8	9.9	5.4	
3	Adjusted taxable gross profit	3.9	4.1	27.2	29.9	122.3	129.3	Row 1 minus row 2
4	Company tax	1.6	1.6	10.9	12.0	48.9	51.7	40% row 3
5	Net profit after tax	2.6	2.7	19.8	19.7	83.3	83.0	Row 1 minus row 4
6	Depreciation	0.7	0.6	3.9	2.3	10.8	6.7	Table 1 row 21
7	Net profit after tax and depreciation	1.9	2.1	15.9	17.4	72.5	76.3	Row 5 minus row 6
8	Total investment	8.4	7.2	53.8	35.0	164.6	115.1	Table 1 row 1
9	Tax rebate on initial allowances	0.2	0.2	2.2	1.2	6.3	3.7	
10	Total investment adjusted for initial allowances	8.2	7.0	51.6	33.8	158.3	111.4	Row 8 minus row 9
11	Rate of return on capital after tax and depreciation	23%	30%	31%	51%	46%	68%	Row 7 as a % of row 10
12	Capital recovery period	3 years	2.6 years	2.6 years	1.7 years	1.9 years	1.3 years	Row 10 divided by row 5

Sources:

Appendix 1 page 24

Table 3

Quantities and costs of equipment and power rating for scale A

Values in £ sterling 1970

	List of equipment	Unit maximum capacity	Total power rating	Estimated daily running time hours [1]	fob price £
	a	b	c	d	e
1	Oil-fired stove	56 lb Syrup per 20 mins 2 gal fuel oil/hr	2 hp	3	580
2	Oil storage tank	500 gal	—	—	40
3	2 copper boiling pans	56 lb	—	—	110
4	Cast iron pouring plate with stand	6 ft x 3 ft	—	—	120
5	Drop roller with stand motor driven	280 lb/hr	0.75 hp	1	220
6	2 pr 7 in drop rollers	—	—	—	260
7	Caramel cutter hand operated	—	—	—	50
8	Sundry equipment	—	—	—	90
9	Spares	—	—	—	40
10	Total	—	2 kVA	—	1,510
11	Insurance and freight	—	—	—	150
12	Total cif	—	—	—	1,660
13	Duty	—	—	—	80
14	Total outlay	—	—	—	1,740

Source:
Machinery manufacturers
Appendix 1 page 25

Footnotes:
[1] assuming an operating efficiency of 80 per cent, see page 23
— nil, negligible, not applicable
---- sub-total

Table 4

Quantities and costs of equipment and power rating for scale B

Value in £ sterling 1970

	List of equipment	Unit maximum capacity	Total power rating	Estimated daily running time hours [1]	fob price £
	a	b	c	d	e
1	Steam boiler, oil-fired	500 lb per hr	1 hp + 1.5 kW	9	1,230
2	2 oil storage tanks	500 gal	—	—	80
3	Batch vacuum cooker	1.2 tons per 8 hr	6 hp	6	3,080
4	Steam jacketed pan with two-speed stirrers	84 lb per 15 min	1.5 hp 0.75 hp	4 ½	2,790
5	4 two-handled aluminium pans	56 lb	—	—	150
6	3 watercooled plates 6 ft x 3 ft with stands	—	—	—	950
7	Hotplate 6 ft x 3 ft with stand	—	—	—	320
8	2 sailcloth covers for hotplate	—	—	—	40
9	Pulling machine	56 lb	3 hp	2	840
10	Rock chopping machine hand oeprated	—	—	—	240
11	Caramel cutter hand operated	—	—	—	50
12	Batch roller, rope sizer, feed table	112 lb	1.5 hp + 200 W	8	2,460
13	Plastic sweetformer, set of dies	1.1 tons per 8 hr	1 hp + 300 W	6	2,050
14	Three tier cooler with blower	1.1 tons per 8 hr	1.8 hp	6	2,560
15	(a) Drop roller machine, motor driven	280 lb per hr	0.75 hp	8	220
	(b) Two pairs 7 in. drop rollers	—	—	—	260
16	Sundry equipment	—	—	—	230
17	Twist-wrapping machine, hand feed	0.6 tons per 8 hr	0.75 hp + 300 W	8	5,000
18	Two air cooling units	16,000 BThU per hr	3 hp + 4.4 kW	16	420
19	Dehumidifier	—	1.2 kW	24	130
20	Spares	—	—	—	920
21	Total	—	24 kVA	—	24,020
22	Insurance and freight	—	—	—	2,400
23	Total cif	—	—	—	26,420
24	Import duty	—	—	—	1,320
25	Total outlay	—	—	—	27,740

Sources:
Machinery manufacturers
Appendix 1 page 25

Footnotes:
[1] assuming an operating efficiency of 80 per cent, see page 23
— nil, negligible or not applicable
--- Sub-total

Table 5

Quantities and costs of equipment and power rating for scale C

Values in £ sterling 1970

	List of equipment	Maximum unit capacity	Power rating	Estimated daily running time hours [1]	fob price £
	a	b	c	d	e
1	Steam boiler, oil-fired	750 lb per hr	1.25 hp + 1.5 kW	9	1,750
2	2 oil storage tanks	500 gal	–	–	80
3	2 batch vacuum cookers	1.2 ton per 8 hr	12 hp	8	6,160
4	Steam jacketed pan with two speed stirrers	280 lb per 20 min	2 hp + 0.75 hp	8 1½	3,290
5	8 two-handled aluminium pans	56 lb	–	–	300
6	12 water-cooled plates 6 ft x 3 ft with stands	–	–	–	3,820
7	4 hot plates 6 ft x 3 ft with stands	–	–	–	1,270
8	6 sailcloth covers for hot plate	–	–	–	110
9	Pulling machine	112 lb	5 hp	4	1,110
10	2 caramel cutters, hand operated	–	–	–	100
11	3 batch rollers, rope sizers, feed tables	112 lb	4.5 hp 600 W	8	7,380
12	2 plastic sweet formers with 2 sets of dies	1.1 ton per 8 hr	2 hp	8	4,100
13	2 three-tier coolers with blowers	1.1 ton per 8 hr	3.6 hp	8	5,120
14	(a) 2 motor-driven drop roller machines	280 lb per hr	1.5 hp	8	440
	(b) 4 pairs 7 in. drop rollers	–	–	–	520
15	Sundry equipment	–	–	–	500
16	Toffee cut-and-wrap machine	1 ton per 8 hr	3 hp 150 W	8	7,000
17	3 twist-wrapping machines, hand feed	0.6 ton per 8 hr	2.25 hp 900 W	11	15,000
18	6 air-cooling units	16,000 BThU per hr	9 hp 13.2 kW	16	1,270
19	3 de-humidifiers	–	3.6 kW	24	390
20	Spares	–	–	–	2,160
21	Total	–	55 kVA	–	61,870
22	Insurance and freight	–	–	–	6,190
23	Total cif	–	–	–	68,060
24	Import duty	–	–	–	3,400
25	Total outlay	–	–	–	71,460

Sources:

Machinery manufacturers
Appendix 1 page 25

Footnotes:

([1]) assuming an operating efficiency of 80 per cent, see page 23
– nil, negligible or not applicable
– – – sub-total

Table 6

Land, floorspace, services, vehicles, labour requirements and costs for scales A, B and C

Values in £ sterling 1970

	Inputs	Unit	Cost in £ per unit	Scale A		Scale B		Scale C	
				Units per year [1]	Cost in £ per year [1]	Units per year [1]	Cost in £ per year [1]	Units per year [1]	Cost in £ per year [1]
	a	b	c	d	e	f	g	h	i
1	Land rent								
	(a) Scale A	'000 sq ft	2.3	2	5	–	–	–	–
	(b) Scale B	'000 sq ft	13.8	–	–	7	100	–	–
	(c) Scale C	'000 sq ft	27.5	–	–	–	–	24	660
2	Floorspace								
	(a) Scale A	sq ft	2.92	1,000	2,920	–	–	–	–
	(b) Scale B	sq ft	2.92	–	–	3,500	10,220	–	–
	(c) Scale C	sq ft	3.50	–	–	–	–	12,000	42,000
3	Electricity								
	(a) Standing charge	kVA	1.75 per month	2	40	24	500	55	1,150
	(b) Running charge	kWh	0.0146	2,000	30	58,000	850	163,000	2,380
4	Fuel oil	gal	0.175	1,500	260	8,100	1,420	12,150	2,130
5	Water	'000 gal	0.292	–	–	240	70	720	210
6	Vehicles								
	(a) Scale A	light van	1,200	1	1,200	–	–	–	–
	(b) Scale B	1½ ton truck	1,800	–	–	1	1,800	–	–
	(c) Scale C	3 ton truck	2,350	–	–	–	–	2	4,700
7	Direct labour	person	–	5	1,580	16	4,350	55	14,500
8	Indirect labour	person	–	1	2,330	2	2,560	5	5,340

Sources:

Machinery manufacturers
Confectionery manufacturers
Appendix 1 page 25

Footnotes:

[1] Where applicable
– nil, negligible or not applicable

Table 7

Quantities (1) and costs of raw materials and supplies for scales A, B and C

Values in £ sterling 1970

	Inputs	Unit	Cost in £ per unit		Scale A		Scale B		Scale C	
			fob	cif	Units per year	Cost in £ per year cif	Units per year	Cost in £ per year cif	Units per year	Cost in £ per year cif
	a	b	c	d	e	f	g	h	i	j
	Ingredients									
1	Sugar (a) HB(2)	long ton	–	80.5	21	1,690	90	7,240	360	28,980
	(b) T(2)	long ton	–	80.5	6	480	30	2,420	120	9,660
2	Glucose (a) HB	long ton	60	66	9	590	60	3,960	240	15,840
	(b) T	long ton	60	66	8	530	40	2,640	160	10,560
3	Fat T	long ton	200	220	3	660	15	3,300	60	13,200
4	Milk T	long ton	134	147	3	440	15	2,200	–	–
		long ton	126	139	–	–	–	–	60	8,340
5	Flavouring (a) HB	long ton of sweet product	1.9	2	30	60	150	300	600	1,200
	(b) T	long ton of sweet product	1.9	2	20	40	100	200	400	800
6	Colouring HB	long ton of sweet product	0.35	0.45	30	10	150	70	600	270
7	Acid HB	long ton	215	237	0.45	110	2.25	530	9	2,130
8	Other ingredients	–	–	–	–	10	–	50	–	140
	Supplies									
9	Containers									
	(a) Plastic bags	'000	3.5	3.9	22.5	90	112.5	440	450	1,750
	(b) Cartons	'000	–	93.3	2.5	230	12.5	1,170	50	4,660
10	Wrapping paper	long ton	515	567	–	–	6.25	3,540	35	19,840

Sources:

Manufacturers and importers
Chapter 1 Method and Appendix 1 page 26

Footnotes:

(1) assuming an operating efficiency of 80 per cent, see page 23
(2) used to distinguish ingredients for manufacture of high boiled sweets HB and Toffees T, detailed in Appendix 1 page 26
– nil, negligible or not applicable

Table 8

Details of personnel and earnings for scales A, B and C

Values in £ sterling 1970

	a	Labour requirements			Wage rate per head per year £			Total cost per year £		
		Scale A b	Scale B c	Scale C d	Scale A e	Scale B f	Scale C g	Scale A h	Scale B i	Scale C j
	Direct labour									
1	Sugar boiler	1	1	2	700	700	930	700	700	1,860
2	Skilled assistant	1	3	10	350	350	350	350	1,050	3,500
3	Semi-skilled worker	–	3	13	–	220	220	–	660	2,880
4	Unskilled worker	3	7	26	180	200	200	530	1,390	5.160
5	Driver and maintenance	–	1	2	–	350	350	–	350	700
6	Driver's mate	–	1	2	–	200	200	–	200	400
	Total direct labour	5	16	55	–	–	–	1,580	4,350	14,500
	Indirect labour									
7	Manager/owner	1	1	1	2,330	2,330	3,500	2,330	2,330	3,500
8	Maintenance engineer	–	–	1	–	–	700	–	–	700
9	Clerk	–	1	2	–	220	220	–	220	440
10	Foreman	–	–	1	–	–	700	–	–	700
	Total indirect labour	1	2	5	–	–	–	2,330	2,560	5,340
	Total labour	6	18	60	–	–	–	3,910	6,910	19,850
	Sales staff									
11	Sales manager	–	–	1	–	–	1,800	–	–	1,800
12	Sales man	–	–	2	–	–	560	–	–	1,120
	Total sales staff	–	–	3	–	–	–	–	–	2,920

Sources:

Confectionery manufacturers
Appendix 1 page 27

Footnotes:

– nil, negligible, not applicable
——— sub-total

Appendix 3

Suppliers, sources of information and conversion factors

LIST OF SUPPLIERS AND SOURCES OF INFORMATION

Information on suppliers of machinery, equipment and other requirements of the sugar confectionery industry may be found in the journal 'Confectionery Production' published monthly by Specialised Publications Ltd, 5 Grove Road, Surbiton, Surrey, England. This journal runs a Readers Problem Service which is free to subscribers and all enquiries from overseas should be addressed to: Problem Department, Confectionery Production, 5 Grove Road, Surbiton, Surrey, England.

Machinery and equipment

1 Brierley, Collier and Hartley Equipment Ltd
Rochdale, Lancashire, England
Small and large scale machinery and equipment

2 Baker Perkins Latin America Ltd
Seacroft, Leeds, England
Twist wrapping machines

3 Hamac-Hansella Maschinen GmbH
4000 Dusseldorf, Cecilienallee 17, Germany
Vacuum cookers, small and large scale machinery and equipment

4 Perkins Boilers Ltd
Derby, England
Steam boilers

5 Temperature Ltd
York Road, London SW11, England
Air conditioning

Materials and supplies

1 British Visqueen Ltd
Stevenage, Hertfordshire, England
Polythene bags

2 Bush Boake Allen Ltd
28 Ash Grove, London E8, England
Colours and flavours

3 Corn Products Sales Ltd
Claygate House, Esher, Surrey, England
Glucose syrup

4 Croda Food Products Ltd
168 High Holborn, London WC1, England
Acids and emulsifiers

5 Loders and Nucoline Ltd
15 Dorset Rise, London EC4, England
Confectionery fat

6 Transparent Paper Ltd
126 Cromwell Road, London SW7, England
Cellulose film for twist-wrapping

Research association

The British Food Manufacturing Industries Research Association, Leatherhead, Surrey, England

Reference books

1 *"Chocolate, Cocoa and Confectionery"*
B W Minifie
Churchill, London 1970, 625pp.
Deals with modern aspects of confectionery technology, shelf life and storage problems.

2 *"Chocolate and Confectionery"*
C T Williams
Hill, London 1964, 222pp.
A text book for students and a reference book for manufacturers.

3 *"Silesia Confiserie Manual No. 1 Handbook for the Sugar Confectionery Industry"*
A Meiners and H Joike
Silesia Gerhard Hanke K G, 4041 Norf, West Germany 1969, 528pp. in four languages, English, German, French and Spanish.
A manual on factory planning and production methods. including a comprehensive list of international machinery manufacturers, publications and conversion tables together with 200 pages of machinery illustrations.

4 *"Skuse's Complete Confectioner"*
Elsevier Scientific Publishing Co, Barking, Essex, England, Thirteenth edition 1957, 344pp.
A standard reference book of recipes for the small scale manufacturer of confectionery.

CONVERSION FACTORS

Metric Units	British Imperial Units
1. Linear Measures	
1 metre = 39.37 inches	1 inch = 0.0254 metre
1 metre = 3.28084 feet	1 foot = 0.3048 metre
1 kilometre = 3,280.84 feet = 0.621372 mile	1 mile = 5,280 feet = 1.609344 kilometres
2. Square Measures	
1 sq metre = 10.763911 sq ft	1 sq foot = 929.0304 sq centimetres
	1 sq foot = 0.092903 sq metre
1 hectare = 10,000 sq metres	1 acre = 43,560 sq feet = 4,840 sq yd
1 hectare = 11,959.89 sq yards = 2.471052 acres	1 acre = 4,046.86 sq metres = 0.404686 hectare
3. Measures of Capacity	
1 litre = 0.219976 imperial gallon	1 imperial gallon = 4.545963 litres
	1 imperial gallon = 277.42 cubic in
	1 imperial gallon = 0.160544 cubic ft
1 litre = 0.264178 US gallon	1 imperial gallon = 1.20095 US gal

4. Weight Measures

1 kilogram = 2.204622 pounds

1 pound = 0.453592 kilogram

1 ton (long ton) = 2,240 pounds

1 metric ton = 0.984207 long ton

1 long ton = 1.01605 metric ton

5. Electric Power

1 kilowatt (kW) = 1,000 Watts

1 kilowatt x 1 hour = 1 kilowatt hour (kWh)

1 horse power (h.p.) = 0.746 kilowatt (kW)

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